Effects of Body Weight on Feeding and Radula Size in the Fresh Water Snail *Pila globosa*

BY

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(2 Text figures)

LAKE IDUMBAN KULAM (Palni, South India) is a permanent aquatic system covering an area of 666 100 m². The annual harvest from the fishery resources of this unmanaged natural pond is about 8 000 kg. The major producers in this system are *Chara* and *Hydrilla,* and *Ceratophyllum* (biomass: 661 g wet weight/m²). A greater part of the plant energy is at present channeled via the most successful and abundant snail population, *Pila globosa* (Swainson, 1822) (biomass: 56 g/m²). Since it is known that experimental determination of food intake and conversion efficiency may offer the most important clues in regard to ecological success of an organism (BRETT, 1970; KINNE, 1971), we have undertaken an extensive investigation to study the ecological energetics of *P. globosa* population with an ultimate view of eliminating it without disturbing other organisms from the ecosystem and thus make more plant energy available for the herbivorous fish populations.

Previous authors have reported the energy balance of a number of mollusks, *e. g., Aplysia* (CAREFOOT, 1967), *Tegula* (PAINE, 1971) and *Scrobicularia* (HUGHES, 1969, 1970). Body weight is known to modify feeding rate and conversion efficiency (*e. g.,* PANDIAN, 1967; GERKING, 1971); however, the above mentioned authors have not given due consideration to the effect of body weight on energy balance of the respective mollusks and their estimates on rate and efficiency of energy transfer by these different molluscan populations may thus include an important source of error. This source of error has been eliminated in assessing ecological energetics of grasshopper populations (DELVI, 1972; see also DELVI & PANDIAN, 1972; PANDIAN & DELVI, 1974). The present paper, first of its series, deals with the effects of body size on the feeding rate of *Pila globosa* and also brings out a correlation between the feeding rate and radula weight with increasing body weight.

More than 100 individuals of *Pila globosa* of the weight range from 1 to 32 g (including the shell) were individually fed *ad libitum* on the natural food plant, *Ceratophyllum,* in the laboratory for a period of 30 to 40 days. Appropriate corrections were made for the amount of plant substance produced due to photosynthesis during the experimental period, in which the plant was fed in the test aquaria (capacity 2 l). The quantity of food consumed by the test individuals varied considerably; frequently, a day of intensive feeding was followed by a day of low feeding. Such day-to-day fluctuations have also been observed in fishes (*e. g.,* PANDIAN, 1967), and in grasshoppers (*e. g.,* DELVI & PANDIAN, 1972, 1973). On averaging the food quantity consumed during the test period (30 to 40 days), a certain trend became apparent. Feeding rate was 24.05 mg/dry plant/g live snail/day in an individual weighing 1 g. It decreased rapidly to about 13.07 mg/g/day for an individual of 4 g and then gradually to 2.12 mg/g/day for the largest animal tested (32 g) (Figure 1). Separate regressions were necessary to calculate the relationship between body weight and feeding rate; individuals weighing up to 4 g were considered under group 1, (the values obtained are indicated by ● in Figures 1 and 2), while those weighing from 4.1 to 24.0 g under group 2 (the values obtained are indicated by ○ in Figures 1 and 2), and those over 24 g under group 3 (the values obtained are indicated by □ in Figures 1 and 2). The regression coefficients were $Y = 23.36 - 2.79x$ for group 1, $Y = 12.54 - 0.43x$ for group 2, and $Y = 3.12 - 0.015x$ for group 3; *i. e.,* they show that for 1 g increase in body weight of the snail, the decrease in daily food intake was 2.79, 0.43, and 0.015 mg

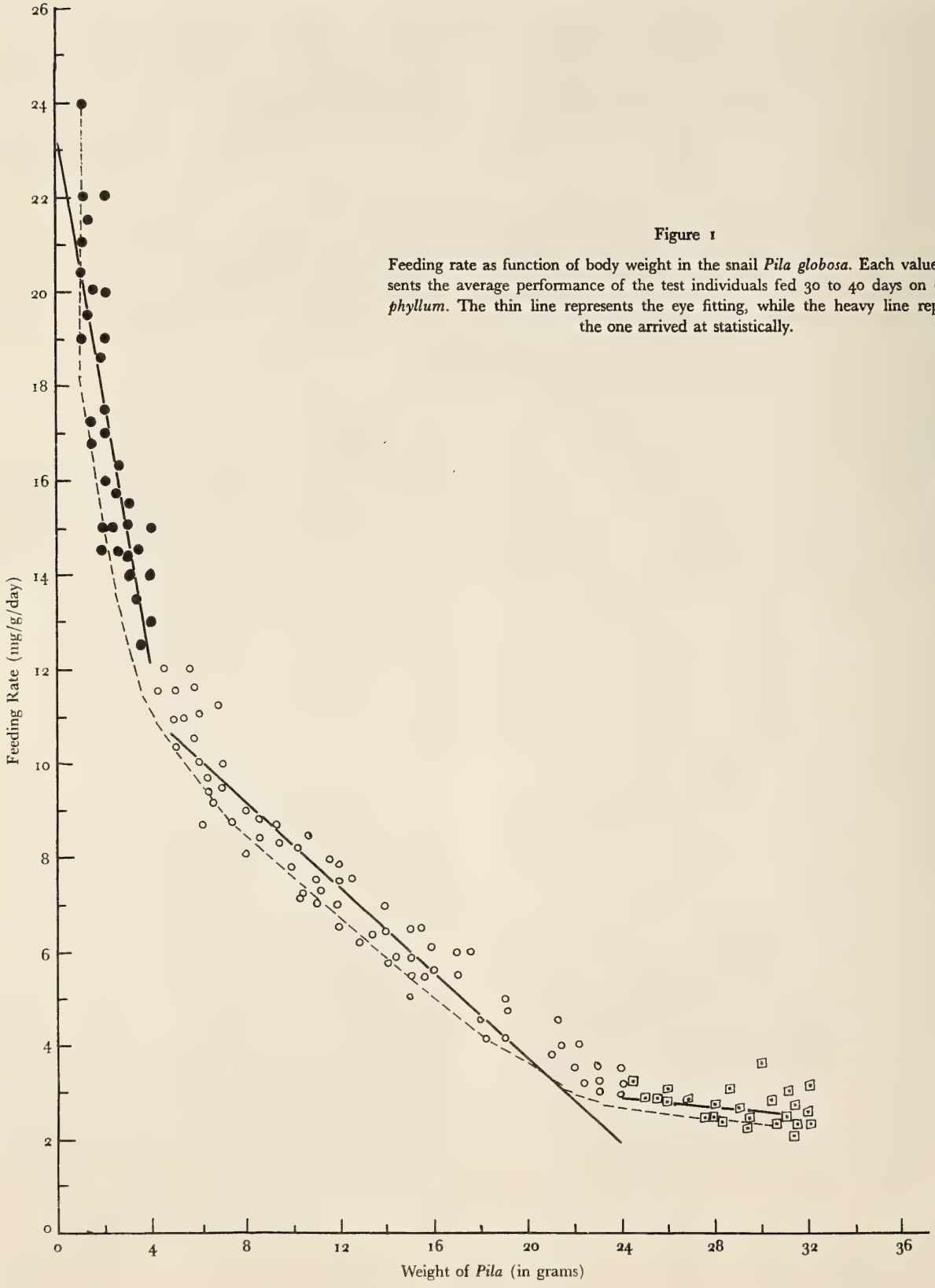

Figure 1

Feeding rate as function of body weight in the snail *Pila globosa*. Each value represents the average performance of the test individuals fed 30 to 40 days on *Ceratophyllum*. The thin line represents the eye fitting, while the heavy line represents the one arrived at statistically.

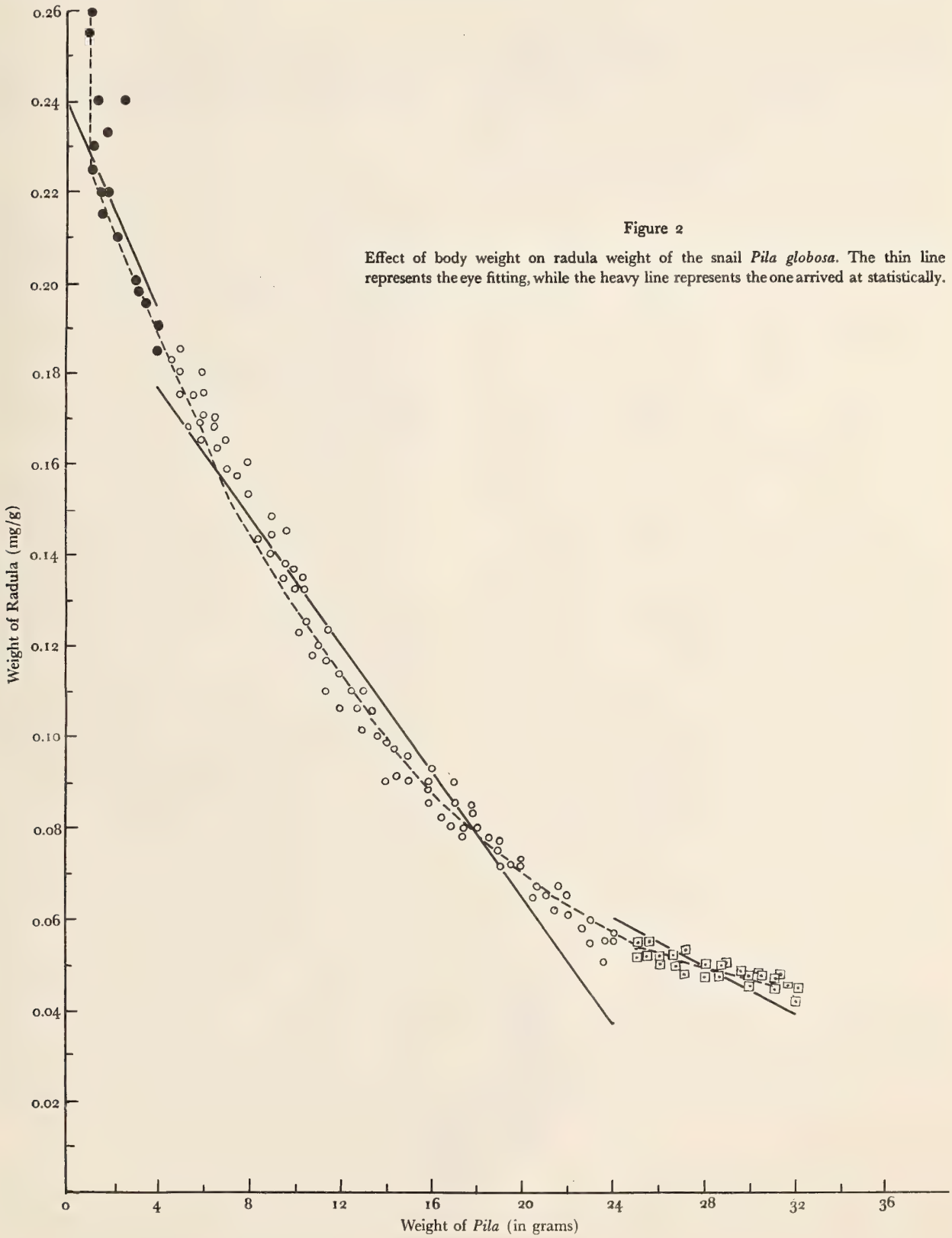

Figure 2

Effect of body weight on radula weight of the snail *Pila globosa*. The thin line represents the eye fitting, while the heavy line represents the one arrived at statistically.

dry plant among the individuals belonging to group 1, 2, and 3, respectively. The data reported for *Pila* fall within the range of values reported by previous workers. For instance, daily food intake of an individual weighing 24 g was 3.12 mg dry plant/g live animal. Carefoot (1970), who studied the effect of different algae on *Aplysia juliana* Quoy & Gaimard, 1832 (mean body weight 24 g), reported a series of values ranging from 0.85 mg dry *Cladophora* /g live *Aplysia*/day to 4.47 mg dry *Enteromorpha*/g live *Aplysia*/day.

It is well known that increase in body weight decreases metabolic level (Zeuthen, 1953; Hemmingsen, 1950, 1960) and hence feeding rate, a sensitive parameter of metabolism. The decrease in feeding rate may be associated with the phenomenon of ageing; ageing is known to operate via the deterioration in the condition of teeth, leading to digestive disturbances and malnutrition in herbivorous farm animals (Brody, 1945). An attempt was made to know whether ageing operates also via deterioration and reduction of the teeth in the herbivorous snail *Pila globosa*. Figure 2 shows that there is a definite decrease of radula (dry) weight as the body weight of the snail increases and that the relation between body weight and radula weight is parallel to that observed for feeding rate-body weight relationships. The regression coefficients obtained were $Y = 0.249\ T - 0.0135x$ for group 1, $Y = 0.205 - 0.007x$ for group 2, and $Y = 0.118 - 0.0024x$ for group 3; *i. e.*, they show that for 1 g increase in body weight of the snail, the decrease in radula weight was 0.0135, 0.007, or 0.0024 mg dry weight among the individuals belonging to group 1, 2, or 3, respectively. Nevertheless, the trends obtained for the relationships are similar, though not identical. Therefore, decrease in radula weight *per se* is one of the important mechanisms through which body weight (or ageing) influences the feeding rate. Further work on enzyme activity and quantity as function of body weight is in progress.

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